

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
Request for Waiver of Measurement)	ET Docket No. 04-352
Procedures for OFDM Ultra-Wideband Devices)	

REPLY COMMENTS OF MOTOROLA, INC.

To: Chief, Office of Engineering and Technology

Motorola, Inc. (“Motorola”) hereby replies to the comments filed in response to the Petition for Waiver submitted by the Multi-band OFDM Alliance Special Interest Group (“MBOA-SIG”) regarding certain measurement procedures applicable to multi-band orthogonal frequency division multiplexing (“MB-OFDM”) ultra-wideband (“UWB”) systems.¹

In its opening round comments, Motorola opposed grant of the requested waiver stating that rather than attempting to create a level playing field as it suggests, MBOA-SIG is in effect seeking a *de facto* rule change to allow multi-band OFDM products to operate with nearly 6 dB more power than direct sequence UWB devices.² Motorola argued that approving this request would be inconsistent with the conservative approach taken by the FCC in approving the initial deployment of UWB devices and untimely as well given that the National Telecommunications and Information Administration

¹ See Request for Waiver of Measurement Procedures for OFDM Ultrawideband Devices, The Multi-band OFDM Alliance Special Interest Group, filed August 26, 2004 (“*MBOA-SIG Waiver Petition*”). See also, Public Notice, ET Docket No. 04-352, released September 3, 2004.

² Comments of Motorola, Inc., ET Docket No. 04-352, submitted Sept. 29, 2004 at 2 (*hereinafter* “Motorola Comments”). Unless otherwise noted, all other comments referenced herein were also submitted in ET Docket No. 04-352 on Sept. 29, 2004.

(“NTIA”) is now conducting additional tests of the interference potential of UWB devices.³ In addition, Motorola stated that the requested waiver is premature as it is not attached to an equipment authorization application for a specific product that clearly comports with all UWB technical standards. In this regard, Motorola also noted that the theoretical design referenced by the MBOA-SIG appears to violate the FCC’s minimum 500 MHz bandwidth requirement for UWB devices.⁴

Motorola’s concerns with the *MBOA-SIG Waiver Petition* were echoed by other parties filing comments on this matter and, in Motorola’s view, the record contains sufficient technical concerns over an increase in potential interference to warrant denial of the subject waiver request. As Motorola argued in its opening round comments, dismissing this waiver, at least until all technical issues are resolved by adequate testing, would not disadvantage the manufacturers of multi-band OFDM devices as they would be free to pursue designs at the same power levels currently authorized to direct sequence UWB devices.⁵ This fact was recently confirmed by the CEO of Staccato Communications, Inc, an MBOA-SIG member company, who has stated publicly that rejection of the waiver request will not impact their product timelines.⁶

³ *Id.* at 5-9.

⁴ *Id.* at 9, 10.

⁵ *Id.* at 2, 3.

⁶ *See*, IEEE 802.15.3a Task Group Berlin Meeting Notes, September 27, 2004, IEEE document 15-04-0497-04-003a-berlin-tg3a-meeting-minutes.doc at 36, (“Roberto Aiello explained the purpose of the waiver request and indicated that a rejection of the waiver request by the FCC would have “no effect” on the product timelines”). *Available at* <ftp://ieee:wireless@ftp.802wirelessworld.com/15/04/15-04-0497-04-003a-berlin-tg3a-meeting-minutes.doc>.

The fact that this waiver request is not critical to the development and deployment of multi-band OFDM UWB devices is perhaps the reason why it received only tepid support by the member companies of MBOA-SIG. Despite the claims of MBOA-SIG that it represents 162 domestic and international companies,⁷ only 12 comments were submitted supporting the *MBOA-SIG Waiver Petition* with most of those providing no significant technical analysis on the effects of the proposed waivers. At the same time, other MBOA-SIG members filed comments in opposition to this waiver request and argued that the petition does not reflect the consensus views of the organization and that their comments and concerns about the relevant UWB measurement procedures were never solicited by the MBOA-SIG.⁸ In Motorola's view, the record reflects discord among MBOA-SIG members which strongly implies that the requested waivers are premature.

While the procedural issues raised by Motorola and other commenters warrant further OET consideration, the focal point of this proceeding should be the increased interference risk to other services and devices should the Commission grant the *MBOA-SIG Waiver Petition*. In its opening comments, Motorola argued that allowing power measurements to be made with the frequency hopping function enabled will allow time averaging effects to understate by nearly 6 dB the energy contained within each

⁷ *MBOA-SIG Waiver Petition* at 1.

⁸ Comments of TimeDerivative, Inc. at 2. Comments of Pulse~LINK, Inc. at 3.

individual pulse.⁹ This across-the-board power increase for UWB devices poses substantial interference risks without adequate data or testing to ensure otherwise.¹⁰

Other commenters buttressed Motorola's general interference concerns. For example, TimeDerivative, Inc. ("TimeDerivative") argues that, in contrast to a 2 nanosecond UWB pulse, the multi-band OFDM burst is so long in time that it is resolvable in any victim receiver with a bandwidth greater than 4.125 MHz.¹¹ This means that the increased power levels that would result from grant of the MBOA-SIG Waiver Petition would result in a "devastating effect on the operation of a victim receiver operating in any bandwidth greater than the 4.125 MHz OFDM tone bandwidth."¹² TimeDerivative's comments quantifies this effect on several representative victim receivers to demonstrate the fundamental conclusion that the interference effects of bursty transmissions are "dramatically more injurious" to a victim receiver than the effect of a continuously transmitting UWB pulse signal at the same average EIRP.¹³

Similarly, Freescale Semiconductor, Inc. ("Freescale") provides analysis showing that a three-hop multi-band OFDM system operating at the maximum power permitted under the waiver would need to be turned down by 5 dB to generate the same interference levels as an impulsive or direct sequence UWB system at maximum power.¹⁴ Freescale

⁹ Motorola Comments at 7.

¹⁰ *Id.*

¹¹ Comments of TimeDerivative at 5.

¹² *Id.*

¹³ *Id.* at 7.

¹⁴ Comments of Freescale at 9.

validates its analysis by providing test data performed with a digital C-band satellite receiver.

In contrast, Philips Electronics North America Corporation (“Phillips”) submits technical data purporting to demonstrate that compared with impulse technology approved under Part 15 of the Commission’s Rules, multi-band OFDM technology will not create any additional potential for interference to licensed operations.¹⁵ Phillips’ analysis is based on studies of Amplitude Probability Distribution (“APD”) plots to characterize the potential for interference to receivers and, in so doing, concludes that multi-band OFDM devices employing a sequence of 3 bands creates less potential for interference than the impulse transmitters anticipated by the UWB rules.¹⁶

Motorola notes that reliance on APD plots is insufficient to characterize the interference potential of multi-band OFDM UWB devices. This conclusion is shared by the NTIA which, as noted by Phillips, has fostered the use of this analytical tool.

In its report assessing the interference potential between UWB and GPS receivers, the NTIA noted that:¹⁷

Characterizing the band limited UWB signal with an APD is not enough. Ultimately the effect that the amplitude statistics have on victim receiver performance has to be determined. . . . Many modern digital receivers use elaborate error correction and time-interleaving techniques to correct errors in the received bit sequence. In such receivers, the corrected BER delivered to the user will be substantially different from the received BER. Computation of BERs in

¹⁵ Comments of Phillips at ii.

¹⁶ *Id.*

¹⁷ Measurements to Determine Potential Interference to GPS Receivers from Ultrawideband Transmission Systems, NTIA Report 01-384, February 2001, at Appendix E-19- E-21. Available at <http://www.its.bldrdoc.gov/pub/ntia-rpt/01-384>.

these receivers will require much more detailed interference information than is contained in the APDs.

This effect of understanding interference impact beyond the statistics described by APD is illustrated in the comments of TimeDerivative which show significant differences on the performance for MB-OFDM systems as proposed by the waiver and non-bursting impulse UWB signals.¹⁸

Motorola, TimeDerivative, Cingular and Pulse~LINK have all noted that the FCC's original UWB decisions contemplated the type of designs proposed by MBOA-SIG and concluded that such systems must be measured with the frequency hopping function disabled.¹⁹ As such, the appropriate vehicle for the proponents of multi-band OFDM devices is to amend the FCC's rules via a petition for rulemaking. Proceeding in the waiver context is clearly inconsistent with the Commission's conservative approach to establishing and enforcing its initial technical standards for ultra-wideband devices. Indeed, adopting this *de facto* 6 dB power increase for certain UWB designs threatens to create regulatory uncertainty that could affect international acceptance of the FCC's leadership in the promotion of UWB technology.²⁰ Absent unambiguous test data

¹⁸ See e.g., Comments of TimeDerivative Inc. at 7.

¹⁹ See e.g., Comments of Cingular Wireless LLC at 5 ("The fact that the Commission was skeptical that swept, stepped, or hopping systems would have sufficient bandwidth to qualify as UWB with the sweep, step function, or hopping stopped does not change the fact that the Commission expressly required that the frequency shifting be stopped for purposes of measurements").

²⁰ If this waiver is granted then Motorola would expect other modulations using a multi-band hopping approach to seek similar relief. For example, one can conceive of a UWB design that complies with the 500 MHz minimum bandwidth with 15 hopping frequencies spread over the 3.1-10.6 GHz band. This would result in power levels 11.7 dB higher than that currently considered by the current rules. Similarly, one can envision a UWB device that needs to transmit information where the average data rate is lower than the peak data rate. This device would only need to transmit for (average data

applicable to real world system designs, OET should not upset the existing level playing field for UWB deployment and should therefore dismiss the *MBOA-SIG Waiver Petition*.

Respectfully submitted,

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October 21, 2004

rate)/(peak data rate) percent of the time. By controlling the amount of time a device is transmitting, the average power inserted into the channel could be kept below the -41.3 dBm/MHz average. Specifically, a device that bursts at 500 Mbps would only need to occupy the channel 1% of the time to 5 Mbps of data. Under the policy contemplated here, such a design could conceivably be permitted to operate with transmit power 100 times greater than -41.3 dBm/MHz. These potential variations of the MBOA-SIG waiver illustrate the problems with establishing technical standards through the waiver process.